

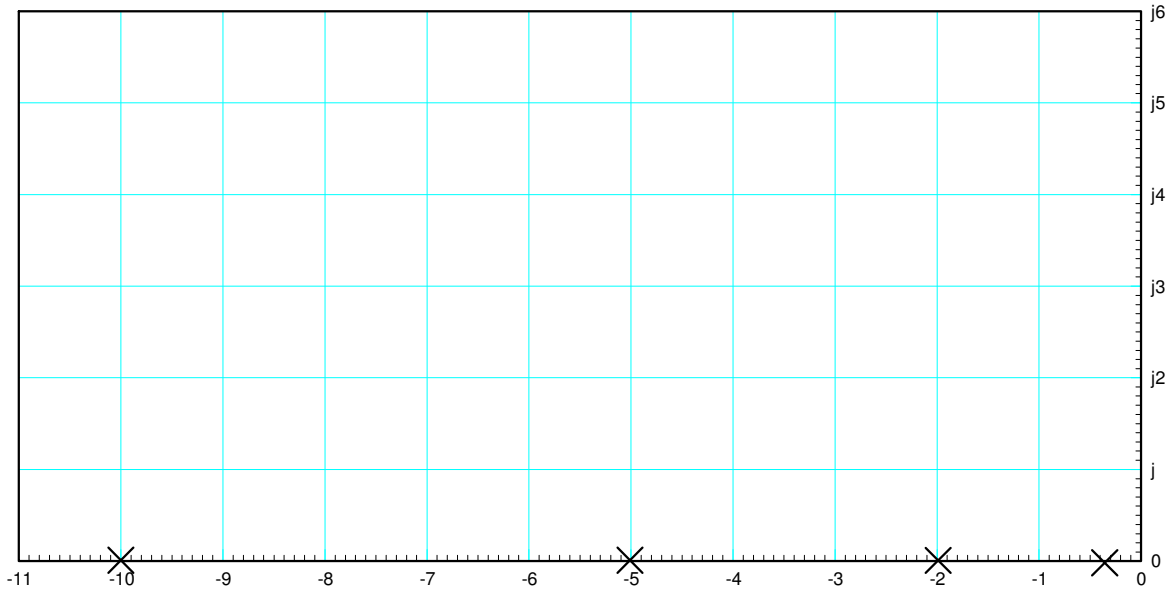
ECE 461/661 Handout #23

Lead Compensation

Design a lead compensator for the following system

$$G(s) = \left(\frac{200}{(s+0.3)(s+2)(s+5)(s+10)} \right)$$

so that the damping ratio is 0.707 (45 degrees)



Solution

Design a lead compensator for the following system

$$G(s) = \left(\frac{200}{(s+0.3)(s+2)(s+5)(s+10)} \right)$$

so that the damping ratio is 0.707 (45 degrees)

Keep the pole at $s = -0.3$. That helps to reduce the steady-state error. Cancel the next slowest pole. Let

$$K(s) = k \left(\frac{s+2}{s+20} \right)$$

$$GK = \left(\frac{200}{(s+0.3)(s+5)(s+10)(s+20)} \right)$$

Option #1: Draw the root locus and find the spot where the damping ratio is 0.707

Option #2: Find the spot along the 0.707 (45 degrees) damping line where the angle of GK is 180 degrees

$$s = -1.878 + j1.878$$

$$\left(\frac{200}{(s+0.3)(s+5)(s+10)(s+20)} \right)_{s=-1.878+j1.878} = 0.1474 \angle 180^\circ$$

$$k = \frac{1}{0.1474} = 6.7864$$

$$K(s) = 6.7864 \left(\frac{s+2}{s+20} \right)$$

